VALVE SYSTEM WITH AIR-READMISSION MECHANISM

Cross-Reference to Related Applications

This is a continuation application of PCT/EP02/01845, filed February 21, 2002, which is incorporated herein by reference in its entirety, and also claims the benefit of German Priority Application No. 101 09 064.1, filed February 24, 2001.

Field of the Invention

The invention relates to a valve system for the metered discharge of a free-flowing product from a container, in particular from a container for cosmetic or dermatological products.

Background of the Invention

Many liquid and cream-like cosmetic products, but also food products, medical, domestic, chemical and technical products are supplied in flexible bottles made of plastic (or in similar containers such as plastic tubes, canisters or the like). These are usually provided with a closure, preferably made of plastic. For product removal, the container is inclined, and, specifically in the case of somewhat more viscous products, the container is compressed in order for product to be discharged. One example is shampoo, which, by virtue of the container being subjected to pressure, is forced out of a relatively small opening, and the container is provided with a hinged lid. If sufficient shampoo has been discharged, the pressure is reduced and the container goes back into its original shape. The action of air being sucked in compensates for the absent volume which has been discharged. It is also the case here that residues of the product which are located in the region of the removal opening are also drawn back into the bottle. In the example of shampoo, these product residues are usually contaminated with spray water, as a result of it being used at a wash basin or in the shower. It is also possible, however, for the residues of shampoo around the pouring opening to be wiped off by hand, and then for sweat, skin residues and other substances on the skin to be sucked in as well.

In the medical sector, there are nose sprays which are sold in flexible bottles. Such bottles are typically configured so that it is possible for virus-containing nose secretions to make their way into the bottle. When using body-care lotions or a suntan milk or oil, it is likewise possible, in addition to air, for other substances (sand, sea water, washing substances) to be sucked back into the container once the product has been applied to the skin.

One particular application is the use of massage heads in order to apply a shower product and to massage the skin. There is a greater possibility here of substances becoming detached from the skin during massage and being sucked into the opening of the massage head. In the food sector, there is the problem of contamination of container contents, for example, when mayonnaise is added to salads or sandwiches or mustard is added to sausages. The substances which are sucked back may often contain bacteria, viruses or fungi. It is thus possible, in particular, for bacteria and fungi to multiply in the contents and thus render the latter unappetizing, inedible or, in extreme cases, even toxic.

The solution to the above problem which has been realized most frequently for products up until now, usually also because it is most cost-effective, is the use of preserving and stabilizing substances (e.g., benzoic acid, formaldehyde formers, nitrates, nitrites, antioxidants, ascorbic acid).

Further attempts are being made to develop technical or structural means of avoiding the contamination of container contents.

The use of closures with relatively small openings and favorable geometry in combination with these substances usually ensures that the problem is kept within reasonable limits. A favorable geometry means that the closure is configured such that contact with the skin or other contaminated surfaces is made difficult.

It is likewise possible for the container to be configured such that no air is drawn in, these configurations being referred to as airless systems. Airless systems

usually have a pump and a container with variable volume, for example a drawing plunger or inner bag (discharged by way of compressed air). These systems are also suitable for multi-chamber systems. The increased outlay usually gives rise to very much higher costs than a flexible plastic bottle. Moreover, residue removal from these systems is usually very poor.

Systems with pumps deliver the substance from the bottle by way of a vertical tube. Volume compensation takes place by way of air which passes into the bottle via a separate channel. The channel is usually provided such that it is only open when the pump is actuated. This means that this channel is closed (usually by the pump plunger itself) in the rest state of the pump, and that this provides a further safeguard against contamination by foreign substances.

Pumping systems are somewhat more advantageous than airless systems, but are still more expensive than straightforward bottles with a closure. The outlay for filling purposes is also higher.

A further development for dispensing systems for containers relates to the installation of valve systems for dispensing free-flowing or similar substances in a controlled manner. In the case of the diaphragm-valve containers which are available on the market, the opening of the vessel is closed by an elastic valve. Applying pressure to the bottle increases the pressure in the container and the valve opens. If the pressure decreases, the valve closes again of its own accord. However, readmission of air is necessary here too, this also taking place via said valve in the case of a corresponding negative pressure in the bottle, product residues and any contamination also being sucked back with such a valve structure. This system ensures that, when not in use, the container is closed and product does not pass out, nor do foreign substances pass in. Moreover, these valves are usually configured such that the stream of substance discharged ceases when the discharge pressure drops below a corresponding value, because the valve then abruptly snaps back and closes the opening. This ensures that the dispensing opening is only

contaminated to a small extent, and the sucking-back action thus also takes place to a lesser extent.

WO 00/06460 describes a valve device which is intended for a container and is fitted in the region of the opening for the metered discharge of a medium. WO 00/07899 and WO 00/07900 disclose valve systems which operate with diaphragms. WO 00/48921 discloses a valve with a two-way function in the case of which the discharge of a liquid and the ingress of air are ensured by both routes being opened at the same time.

Summary of the Invention

One embodiment of the invention provides a valve system for a container that: (1) ensures that the container contents are dispensed; (2) allows readmission of air; and (3) prevents the product, once dispensed, from flowing back into the container. These measures are intended to avoid the disadvantages of the prior art.

A valve system according to one embodiment of the invention is configured for the metered discharge of a substance from a container. In this embodiment of the invention, a dispensing opening is provided through at least one of the walls of the container for discharging the substance from the container. In addition, an air-admission opening is provided through at least one of the walls of the container for the readmission of air. This valve system has a first valve (discharge valve), which seals the dispensing opening for the substance as long as a pressure difference between the interior of the container and the exterior of the container is smaller than a first predetermined limit value and which opens the dispensing opening for the substance if the pressure difference between the interior of the container and the exterior of the container as larger than the first predetermined limit value, and also has a second valve (air-admission valve), which opens the air-admission opening for the readmission of air as long as the pressure difference between the interior of the container and the exterior of the container is smaller than a second predetermined limit value and which seals the air-admission opening for the readmission of air if the pressure difference between the interior of the container

and the exterior of the container is larger than the second predetermined limit value. The second valve here comprises of a flexible material and is designed in the form of a lip which is capable of closing the air-admission opening. This closure may preferably take place such that the lip positions itself over the air-admission opening and seals the latter. The variants in which the lip or parts thereof penetrates/penetrate, in part, into the air-admission opening, and thus achieves/achieve sealing, is also advantageous.

To avoid misunderstanding, the pressure difference between the interior of the container and the exterior of the container is defined as the internal pressure of the container minus the external pressure of the container in the correct mathematical values, that is to say ones provided with an algebraic sign. Giving the mathematical values provided with an algebraic sign likewise applies to the way in which the first and the second predetermined limit values are given.

The first valve is thus advantageously closed as long as a positive pressure in the interior of the container in relation to the exterior of the container is smaller than a first predetermined limit value, and is open if the positive pressure is larger than the first determined limit value. Correspondingly, the second valve is open in the case of a negative pressure in the interior of the container in relation to the exterior of the container, and is advantageously closed when this negative pressure is not present.

The air-admission opening should advantageously be closed by the air-admission valve in the state in which the internal pressure of the container corresponds approximately to the external pressure, since otherwise, if the bottle is not being used, substance can run out through the air-admission channel. The second limit value may preferably be selected correspondingly, preferably approximately zero. It is also possible to select a negative value for the second predetermined limit value, in particular if the container is secured against leakage in some other way, for example if it is configured as a stand-up container.

In the case of a preferred embodiment of the inventive valve system, the first valve has a closure part, which is of essentially conical configuration, and in particular three crosspieces, which connect the closure part to the surrounding container and which are made of a resilient material.

The inventive valve system can be used very advantageously for containers in which the region of the dispensing opening is designed in the form of a neck, this neck preferably having a round or oval cross section, the air-admission opening being located in a side wall of this neck, and the dispensing opening preferably being located at that end of the neck which is located opposite the container.

It is advantageous, furthermore, if a plurality of air-admission openings, which are provided for the readmission of air, are located in the region of the neck.

In the case of a very preferred embodiment of the inventive valve system, the second valve is designed as a sleeve-like lip which runs around the inner wall and is capable of closing all the air-admission openings for sealing purposes. "Runs around the inner wall of the neck" is to be understood here as meaning that the sleeve is capable, in the case of an increase in pressure, of positioning itself wholly or partially against the inner wall, or of penetrating wholly or partially into the same, and thus of sealing the openings. In the case in which the pressure difference between the interior of the container and the exterior of the container is no larger than the second predetermined limit value, as discussed in regard to the embodiments shown in the drawings, this sleeve should butt against the wall.

The valve is thus sealed when the container is not in use ("rest state"); even in the case of a small negative pressure in the container, pressure equalization takes place by virtue of air flowing in.

Brief Description of the Drawings

The invention will be illustrated in more detail hereinbelow using drawings, although the selection of the illustrated embodiments should not be regarded as restricting the invention to the embodiments shown.

Figure 1 shows the region of the discharge opening in a container having a valve system according to one embodiment of the invention.

Figure 2 shows the valve element of a valve system according to a particular embodiment of the invention.

Figure 3 shows the region of the discharge opening in a container having a valve system according to one embodiment of the invention. In this figure, the discharge valve is in an open position.

Figure 4 shows the region of the discharge opening in a container having a valve system according to an embodiment of the invention. This figure shows the route taken by air as the air enters through the open lip valve during the readmission of air.

Figure 5 shows the region of the discharge opening in a second embodiment of a container having a valve system according to an embodiment of the invention.

Detailed Description of the Drawings

Figure 1 shows a container, in this case in particular for cosmetic preparations, in the region of the discharge opening. In this region, the container is designed in the form of a neck **1**. An attachment part **3** which has an internal thread, and contains the inventive valve system, can be screwed onto said neck **1**, which is provided with a corresponding screw thread **2** on its outside. In the embodiment illustrated here, the attachment part **3** is provided with a component **16**, which can be plugged, clipped, welded or similarly fitted into the attachment part **3**, a reversible fastening also being possible. This component **16** is fastened in a sealing manner all the way round in relation to the attachment part **3**. It is also possible, however, for

the attachment, comprising the parts **3** and **16**, to be configured in one piece. The container can be closed by a hinged lid **9**, which is connected to the container by the hinge **8**.

The attachment part **3** has an antechamber **4** that is configured such that, with the attachment part **3** screwed on, the container is sealed in the region of the designations **5**, with the result that a substance located in the container cannot escape here at any time. The wall of the antechamber **4** contains a discharge channel **6**, at the top end of which the discharge valve **7** is located. The antechamber **4** is sealed all the way round in relation to the component **16**.

The discharge valve **7** is designed in the form of a preferably conically tapering closure part **13** for the dispensing opening **14**; the dispensing opening **14** is preferably also conical. A plan view of the valve element **7** (discharge valve) is shown in Figure 2. The closure part **13** is connected to the container, in this case to the component **16**, by a plurality of flexible or resilient crosspieces **15**. In the embodiment illustrated here, the connection is realized by three s-shaped crosspieces **15** made of a flexible material. If a pressure is then exerted from the interior of the container, the closure part **13** is raised and releases from the dispensing opening **14**. This allows the substance to pass out of the container. The closure part **13** is retained in the raised position (see Figure 3). The increase in the distance between the closure **13** and the surrounding component **16** is achieved in that, during this operation, the crosspieces **15** lose the s-shape and are straightened out (in an alternative embodiment it is possible to use, as crosspieces, for example helical springs, which are expanded during the operation, or else, generally an elastic or expansible material). If the pressure in the interior of the container is reduced again, then the closure part **13** is lowered on account of the restoring force of the crosspieces **15** and closes the dispensing opening **14** again, with the result that no residual substance can flow back into the container. The hinged lid **9** may advantageously be configured such that, in the closed state, it presses the closure part **13** into the dispensing opening **14** and thus improves the sealing.

In order to perform its function, the closure part **16** may also have a geometry which is other than conical (sphere, ellipsoid, cylinder, etc.).

The readmission of air in order to achieve pressure equalization between the interior of the container and the exterior of the container takes place via air-admission openings **10**, which are located in the wall between the antechamber **4** and the exterior of the container. In the figure illustrated here, these air-admission openings **10** are located in the attachment part **3**. This ensures the passage of air (see the dashed-line arrow in Figure 4) through the screw thread **2**.

The air-admission openings **10** may be closed by an air-admission valve **11**. This air-admission valve **11** is in the form of a lip, in this case in particular of a sleeve of lip-like cross section running around the antechamber **4**, and is made of a flexible material. In the top region, this sleeve (air-admission valve **11**) is fitted in the component **16**; the bottom part projects into the antechamber **4** and is preferably formed such that it is inclined in front of the air-admission openings **10**. If the pressure in the container is increased, this gives rise to the conditions shown in Figure 3: the substance located in the container passes in through inlet openings **12** in the base of the antechamber **4**. By virtue of the pressure (air pressure or pressure from the substance which has passed in) increasing in the antechamber **4**, the air-admission valve **11** is pressed onto the air-admission openings **10**. The air-admission valve **11** is preferably of thin-walled configuration in the bottom region, with the result that the pressing action is greatest here. The valve for the substance located in the container closes off in a sealed manner in the region of designations **17**; the air-admission openings **10** in this case are closed. It is not possible for substance to pass out here.

If the pressure difference between the internal pressure of the container and the external pressure is smaller than a predetermined limit value, then the air-admission valve **11** opens and allows air to pass in through the air-admission openings **10** and in the downward direction, out of the air-admission valve **11**, into the antechamber **4** until the negative pressure in the container is more or less

equalized. In Figure 4, a dashed-line arrow is used to illustrate the route taken by the air as it passes in at the open air-admission valve **11** for that embodiment of the invention which is illustrated here (in the region of the screw thread **2**, the air can pass in along this screw thread **2**).

The encircling, sleeve-like configuration of the air-admission valve **11** ensures that, when the internal pressure of the container is increased, this air-admission valve **11** is subjected uniformly to the pressure and the air-admission openings **10** are thus closed uniformly. The best possible sealing can be achieved as a result.

Figure 5 shows, by way of example, a container with an inventive valve system in which, with an otherwise similar construction of the container, the discharge valve **7** is configured in an alternative manner.

The fixable component **16** here contains one or more dispensing openings **20**, which can be closed and opened by the discharge valve **7**. This valve comprises a valve plate **18** made of a flexible material, preferably, for example, rubber, and has a through-passage opening **19** which is positioned such that, in the closed state, the dispensing openings **20** of the components **16** and the through-passage opening **19** of the valve plate **18** are not located one above the other. The valve plate **18** here is fastened on the component **16** by way of its outer border.

If the pressure in the interior of the container is increased, then the valve plate **18** is raised and releases the through-passage for the substance which is to be dispensed from the interior of the container, in that it is possible for this substance, in the first instance, to flow through the dispensing openings **20** and then to flow along between the valve plates **18** and the component **16** as far as the through-passage opening **19**, and to pass out through the latter.

The valve plate **18** may be fastened in different ways on the component **16**; only a few examples are mentioned hereinbelow. For example, the border of the valve plate **18** may be adhesively bonded to the component **16**, or it can be

positioned in a corresponding milled recess in the component **16**, in which case additional adhesive bonding is advantageous here too, and as an alternative, or in addition, the valve plate **18** may be fixed on the component **16** by corresponding retaining rings. Furthermore, it is possible for the valve plate **18** to be produced in a single piece with the component **16** by multi-component injection molding. A further variant is to configure the lips of the air-admission valve **11** and the valve plate **18** in one piece by producing this single-piece component by injection molding, in which case it is molded, in part, in corresponding cutouts in the component **16**.

The readmission of air, in the case of this embodiment, takes place in a manner analogous to the variant outlined above (Figure 4).

Dispensing devices according to various embodiments of the invention may comprise the valve systems described herein according to an embodiment of the invention to be integrated with special applicators. The inventive valve system or one of its embodiments is/are designed such that it is not possible for a product, once dispensed, to flow back from the applicator surface into the container. They are thus suitable for containers for free-flowing substances of all types, but, in addition, provide great advantages for containers which are envisaged for dispensing easily perishable substances or which have to satisfy stringent hygiene-related requirements.

A few examples of such application areas, without this being claimed as a complete list, are as follows:

- Toothbrushes with integrated dispensing opening
- Cleaning brushes with an integrated supply container
- Grinding and polishing applicators in the corresponding container for auxiliary agents
- Shower-gel applicators, in particular also with a massage head
- Mascara brushes

- Applicators for shoe creams or other cleaning and treating/preserving substances, in particular those with a brush or a sponge and the container for cleaning clothing
- Roll-on deodorants
- Applicators for nail polish or correction fluid
- Applicators for adhesives
- Applicators for paints, protective coatings, rust removers, caustic lyes etc.

The valve system is also highly suitable for the conventional container closures and applicators, including, for example, containers for substances for washing and body care (shampoo, shower gel, suntan milk, body-care lotion, etc.). As a result of contamination of the contents being more or less ruled out, the amount of preserving and stabilizing substances can be reduced to a considerable extent. Moreover, the contents do not become cloudy, which in many cases is regarded as detracting from quality.

A further application for the inventive valve system is in the food sector, for example for jam, honey, ketchup and mayonnaise, mustard, sauces and the like.

Such a configuration of the closure reduces the loss of easily volatile substances such as perfume, alcohol, essential oils, etc., even if the lid is not closed carefully or in the case of the container being configured without a hinged lid.